SNOWY MOUNTAINS
HYDRO-ELECTRIC AUTHORITY

THE Facts

THE SNOWY SCHEME - AN ENGINEERING WONDER

The Snowy Mountains Scheme is one of the great engineering feats of the modern world, and remains amongst the greatest engineering projects undertaken in Australian history.

The Scheme is one of the most complex integrated water and hydro-electric power schemes in operation—diverting water for irrigation west to the Murray and Murrumbidgee river systems and producing clean, renewable energy for south-eastern Australia.

It took 25 years to build the Snowy Mountains Scheme—work commenced in 1949 and construction was completed in 1974—on time and under budget.

Engineering history in the making

1949 On 17 October, construction of the Snowy Mountains Scheme began with an opening ceremony at Adaminaby.

1954 Guthega Dam and Power Station were completed. Work on the complex began in 1951. American and French companies were contracted to build the next part of the Scheme—the Upper Tumut Diversion.

1955 On 23 April, Prime Minister Sir Robert Menzies officially turned on the power at Guthega. The power station went on to save Sydney from almost 50 power blackouts in its first year of operation.

1958 An Australian company, Thiess Brothers, won the contract to build Tooma Dam and the Tooma-Tumut Tunnel. This was the first major contract let to an Australian company.

1962 The Upper Tumut works (Tumut 1 and Tumut 2 Power Stations and the Tantangara and Tooma projects) were completed.

1966 The first waters of the Snowy Murray Diversion were diverted west to the Murray River catchment, and the first unit of Murray 1 Power Station commenced commercial operation.

1967 The American Society of Civil Engineers rated the Snowy Mountains Scheme as one of the seven civil engineering wonders of the world.

1968 The first release of irrigation water from Blowering Dam was made by the Premier of New South Wales, the Honorable R W Askin.

1972 Tumut 3 Power Station was officially opened.

1974 The Lower Tumut works (Tumut 3 Power Station, Jounama Dam and Blowering Dam projects) were completed.

1997 The Snowy Mountains Scheme was named an International Historical Civil Engineering Landmark by the American Society of Civil Engineers.

Engineering firsts

Several important advances in construction techniques were made during the construction of the Snowy Mountains Scheme—many by the Snowy's own Engineering Laboratories in Cooma.

The most significant of these was the development of a technique called rockbolting—a safer and cheaper alternative to concrete lining for supporting rock in tunnel walls. An individual rockbolt was usually used to pin a piece of rock to the rock wall behind it. However, a Snowy design team found that by placing rockbolts in a pattern across the roof of the tunnel or power station, so one interacted with the other, they created a structural arch.

In 1951, the Snowy launched a study to find the most economical system for power transmission. The highest voltage in use in Australia at the time was 132 kV. However, the Snowy decided to install transmission lines of 330 kV, which have become standard throughout NSW.

Other advancements made by the Snowy included installing high-speed Francis turbines and developing new methods of diamond drilling.

Tumut 3 Power Station was the first major pump-storage scheme in Australia. Pump-storage schemes use cheap off-peak energy to pump water to a reservoir on a higher level. This water then passes through turbines to generate electricity when prices are higher.

Another feature of the construction of the Scheme was the increasing rate of progress achieved by contractors, particularly in hard rock tunnelling. Consequently, all contracts were completed ahead of schedule or on time. Earth and rock filling for Eucumbene Dam, for example, was completed in two years—less than half the time allocated under the contract.

First in Snowy computers

In the early 1950's, engineers of the Snowy Mountains Hydro-electric Authority were using a CSIRO Mechanical Differential Analyser—a mechanical machine or 'computer' used to solve mathematical problems—to solve flood-routing problems.

By the mid-1950s, the Snowy supported a project to develop a Digital Differential Analyser. This was undertaken as a joint project of the School of Electrical Engineering at the University of Sydney and the Mathematical Instruments Section of the CSIRO.

However, a series of investigations in 1957 determined that a general-purpose computer would better meet the Snowy's requirements than would a digital differential analyser. In 1958, the Snowy funded the design and construction of a semiconductor, general-purpose digital computer. Commissioned in August 1960, the Snowy Mountains Computer, or SNOCOM, was the first computer of its type constructed and installed in Australia.

Exchanges in engineering excellence

When the Snowy Mountains Hydro-electric Authority was established, there was an acute shortage of engineers, surveyors, geologists, technicians and tradesmen in Australia.

To speed up design of the Scheme, an agreement was made between the USA and the Commonwealth of Australia under which the United States Bureau of Reclamation provided assistance to the Snowy. This included preparing designs and specifications for some of the civil engineering works and arranging training facilities on large projects in America for the Snowy's engineers. Over 100 engineers received training in the USA under this agreement.

It wasn't long, however, until the expertise of the Snowy engineers was sought overseas in Asia and Pacific nations. At the completion of the Scheme, the major contractors moved onto new projects in South America, Asia and other developing countries, taking with them a core of miners, tradesmen and operators. While some of those who worked on the Scheme returned to Europe, many stayed behind, branching out on their own projects here and abroad.

In the 1970s, most of the Scheme's design and construction staff transferred to a second organisation, the Snowy Mountains Engineering Corporation (SMEC). SMEC was formed in 1972 as the construction of the Snowy Mountains Scheme wound down. Today, SMEC is a private company owned by its employees which continues to provide skills and expertise in engineering, project management and organisational restructuring across Australia and around the world.

Continued engineering excellence

The Snowy Mountains Hydro-electric Authority's approach to engineering excellence has continued in the ongoing operation and maintenance of the Scheme, ensuring the reliability and integrity of the Scheme for hundreds of years to come.

Recent projects undertaken on the Scheme include:

- A five year, $19.2 million total refurbishment of all the 14 generating units at Murray 1 and Murray 2 Power Stations. Commenced in 1997, the project is the most significant maintenance program undertaken at these power stations since they were commissioned. The project will maximise the life of the generators and ensure the continued reliable operation of these machines for the next 20 years.
- A four year, $50 million total refurbishment of the eight generating units and control systems at Tumut 1 and Tumut 2 Power Stations. The project was completed in 1995.
- Commencement of a three year, $9 million Integrated Scheme Control project. The project will allow all of the Scheme's generating, pumping and hydraulic equipment to be supervised, monitored and controlled from one central site, the Snowy Mountains Control Centre in Cooma.

Dams, tunnels and power stations

Operating over an area of 8,200 square kilometres, the Scheme's 145 km of interconnected trans-mountain tunnels and 80 km of aqueducts collect and divert most of the inflows to the Snowy Mountains area.

There are seven power stations, a pumping station and 16 major dams, including Blowering Dam, which was initially built for the NSW Water Conservation and Irrigation Commission, and is now operated by the NSW Department of Land and Water Conservation. (A dam is the barrier across a river to hold back water, while a reservoir is the body of water held behind a dam.)

The following table provides a summary of the principal features of the Snowy Mountains Scheme's vast network of dams, tunnels and power stations.

Summary of Principal Features

Dam	Type	Height metres	Crest Length metres	Gross Reservoir Capacity 10^3m^3	Year of Completion
Talbingo	Rockfill	161.5	701.0	920,600	1970
Eucumbene	Earthfill	116.1	579.1	4,798,400	1958
Blowering	Rockfill	112.2	807.7	1,632,400	1968
Geehi	Rockfill	91.4	265.2	21,100	1966
Tumut Pond	Concrete Arch	86.3	217.9	52,800	1959
Jindabyne	Rockfill	71.6	335.3	689,900	1967
Tooma	Earthfill	67.1	304.8	28,100	1961
Island Bend	Concrete Gravity	48.8	146.3	3,020	1965
Tumut 2	Concrete Gravity	46.3	118.9	2,700	1961
Tantangara	Concrete Gravity	45.1	216.4	254,100	1960
Jounama	Rockfill	43.9	518.2	43,500	1968
Murray 2	Concrete Arch	42.7	131.1	2,300	1968
Guthega	Concrete Gravity	33.5	139.0	1,550	1955
Happy Jacks	Concrete Gravity	29.0	76.2	270	1959
Deep Creek	Concrete Gravity	21.3	54.9	5	1961
Khancoban	Earthfill	18.3	1,066.8	21,500	1966

Tunnel	Length kms	Year of Completion
Eucumbene-Snowy	23.5	1965
Eucumbene-Tumut	22.2	1959
Murrumbidgee-Eucumbene	16.6	1961
Snowy-Geehi	14.5	1966
Tooma-Tumut	14.3	1961
Murray 1 Pressure	11.8	1966
Tumut 2 Pressure and Tailwater	11.3	1961
Jindabyne-Island Bend	9.8	1968
Guthega	4.7	1955
Murray 2 Pressure	2.4	1969
Tumut 1 Pressure	2.4	1959
Tumut 1 Tailwater	1.3	1959

Power Station	Installed Capacity MW*	Number of Units	Year of Completion
Tumut 3	1,500	6	1973
Murray 1	950	10	1967
Murray 2	550	4	1969
Tumut 1	329.6	4	1959
Tumut 2	286.4	4	1962
Blowering	80	1	1969
Guthega	60	2	1955

Pumping Stations	Number of Units	Year of Completion
Tumut 3	3	1973
Jindabyne	2	1969

Dam Types:

Rockfill: an embankment dam with more than 50% of its volume composed of compacted or dumped rockfill, eg. Talbingo Dam.

Earthfill: an embankment dam consisting of less than 50% rock, constructed of compacted impervious earth and filter materials protected by rock, eg. Eucumbene Dam.

Concrete gravity: a concrete mass dam, usually either straight or curved in design, eg. Island Bend Dam.

Concrete arch: a concrete mass dam, curved in design with the convex curvature facing upstream, eg. Tumut Pond Dam.

Recommended Snowy publications

Snowy Mountains Hydro-electric Authority Annual Report 1997-98.

The Power of Water: The Story of the Snowy Scheme, Snowy Mountains Hydro-electric Authority, 1997.

The Power of Water, A teacher resource kit for upper primary school students, Snowy Mountains Hydro-electric Authority, 1996.

Engineering Features of the Snowy Mountains Scheme, (3rd ed.) Snowy Mountains Hydro-electric Authority, 1993.

The Facts, Information sheet series, Snowy Mountains Hydro-electric Authority, 1997.

watt = the unit of power (the rate of doing work)

kilowatt hour (kWh) = the standard unit of energy for electricity consumers

***megawatt (MW)** = one million watts or one thousand kilowatts

gigawatt hour (GWh) = one million kilowatt hours

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